Abstract

The administration of sliding scale insulin continues to be the primary form of glycemic management used in hospitals for the management of hyperglycemia in patients with diabetes. However, basal-bolus insulin regimens have been demonstrated by research to create more advantageous patient outcomes than sliding scale insulin. The purpose of this pilot study is to identify perceived barriers among nursing staff regarding implementation of a basal-bolus insulin standard for the management of inpatient hyperglycemia in hospitals and test a mixed-methods survey for future quantitative research. The survey tool was designed to obtain unique, self-reported information from practicing inpatient nurses and collect data regarding nurse confidence and familiarity with different types of insulin administration. A convenience sample of nurses from two units in a major medical center was surveyed electronically based upon principles used in similar previous research involving providers. Results indicate that nurses report lower levels of confidence with administration of multiple insulin types than with sliding scale insulin, and that they place a high priority on glycemic treatment and preventing hypoglycemia in patients. Results also indicate that fear of medication errors and causing hypoglycemia were primary nursing barriers among those surveyed. Identified response themes and common barriers have implications for future research, as well as education and policy efforts undertaken by medical centers when instituting basal-bolus insulin regimens as standard practice or hospital policy.

Introduction

In 2014, 29.1 million people in the United States had diabetes in some form, and Type 2 diabetes mellitus accounts for 90-95% of total diagnosed cases of diabetes (Centers for Disease Control and Prevention [CDC], 2014). The administration of sliding scale insulin (SSI) continues to be used as a primary form of glycemic management in hospitals for patients with diabetes: however, a basal-bolus insulin (BBI) regimen works to more closely mimic the body's natural insulin production and release systems, and research has demonstrated that BBI is associated with more advantageous patient outcomes (Umpierrez et al., 2007; Lee et al., 2015). Despite this, surveys of provider perceptions surrounding insulin protocols have indicated that SSI regimens are often considered a less complex, and more comfortable, choice of glycemic management protocols by providers when compared to BBI regimens (Cheekati, Osburne, Jameson, & Cook, 2009; Latta et al, 2011). While research into provider comfort levels exists, limited data is available with regard to the comfort level and potential barriers of nursing staff to the implementation of a basal-bolus protocol as standard hospital policy for the treatment of hyperglycemia.

The purpose of this study is to identify and explore perceived barriers to implementing a BBI dosing standard for the management of inpatient hyperglycemia in hospitals. This initial research is designed to obtain unique, self-reported, quantitative and qualitative information from practicing inpatient nurses in order to examine nurse confidence and familiarity with different types of insulin administration. This study further seeks to determine the validity of a future, strictly quantitative survey. By using both open ended question and quantitative formats, this initial study allows nurses to self-report their experiences and primary concerns regarding hyperglycemia management in hospitals. Analysis of responses supports the identification of

common trends and similarities to prior, provider-focused research on implementation barriers, as well as the identification of nursing-specific barriers and potential opportunities for education. Results will be used to design and implement a more comprehensive quantitative survey for the purpose of surveying a larger, broader population of nurses, in order to validate and expand on the results of this survey and collect meaningful data that can guide future policy change protocols and education efforts in hospitals.

Background

According to statistics released by the Centers for Disease Control and Prevention in 2014, 29.1 million people in the United States have diabetes in some form. Of those, nearly a third who are living with diabetes (8.1 million people) are undiagnosed (CDC, 2014). Type 2 diabetes mellitus (T2DM) accounts for 90-95% of total diagnosed cases of diabetes, with Type I diabetes mellitus (T1DM) accounting for the remaining 5-10% (CDC, 2014). The cost of diabetes treatment in the U.S. in 2012 was estimated at $245 billion dollars, with $68 billion of that cost being represented by lost work, disability, and premature death (CDC, 2014).

Much of the cost of diabetes can be associated with the comorbid conditions related to the disease. Diabetes significantly increases the risk of hypertension, heart disease, stroke, kidney disease, neuropathy, retinopathy, and lower limb amputations especially if the diabetes is not adequately managed (CDC, 2014; Clement et al., 2004). Numerous studies have found that inpatient control of hyperglycemia improves hospital outcomes by reducing prevalence of T2DM comorbidities, shortening patients' length of stay, and reducing diabetes-associated mortality (Clement et al., 2004; Cheekati et al., 2009; Garber et al., 2016).

Most patients with T2DM require insulin administration for glycemic control while being treated in an inpatient hospital setting, and the choice of insulin administration protocols can

have a large impact on patient outcomes (Browning, 2004). Subcutaneous insulin administration is the most prevalent form of glycemic control used in hospitals, and consists of sliding scale (correctional only) or basal-bolus (basal plus nutritional insulin coverage) protocols. However, while SSI is the most widely used protocol for glycemic control in non-critical patients, research has demonstrated that it is a far less advantageous practice when compared to BBI regimens (Umpierrez et al., 2007; Lee et al., 2015).

Sliding Scale versus Basal-Bolus Treatment

The administration of SSI regimens, also referred to as correctional or correctional-only insulin, has been used as a glycemic management method since its introduction to practice in 1934 (Nau, Lorenzetti, Cucuzzella, Devine, & Kline, 2010). The protocol traditionally requires that patients receive pre-prandial and pre-bedtime finger-stick blood glucose testing if they are eating, or testing every six hours if they are not, with the results being used to calculate the amount of insulin needed to regulate the patient's blood glucose within acceptable ranges. The ADA currently recommends a blood glucose range of between 140-180 mg/dl for hyperglycemic patients receiving insulin treatment. Tighter ranges, sometimes as low as 80-110 mg/dl, had previously been recommended but research has shown no benefit in most populations to maintaining blood glucose levels below 140 mg/dl (ADA, 2016). SSI protocols typically do not take into account a patient's basal insulin needs, diet, or other patient-specific modifiers to insulin need (such as insulin sensitivity) when determining the amount of insulin to provide, and are considered to be a reactive, rather than proactive, approach to blood glucose management (Nau et al., 2010). Sliding scale regimens can lead to rapid changes in blood glucose levels in patients; prolonged or intermittent hyperglycemia despite insulin treatment; hypoglycemia related to insulin stacking or unexpected alterations in nutritional intake or activity levels; and

less advantageous outcomes, such as higher incidence of infection and longer hospital stays for patients (Hassan, 2007; Browning, 2004).

In contrast to SSI's reactive treatment methodology, a basal-bolus insulin regimen works to more closely mimic the body's natural insulin production and release systems. A 'basal' insulin dose is provided through use of long acting insulin, such as glargine, which has no peak over its duration, an onset of 2-4 hours, and lasts for 24 hours (Datta, Qaadir, Villanueva, & Baldwin, 2007). A bolus of rapid-acting insulin can then be given prior to meals (nutritional insulin) in order to cover oral carbohydrate intake, and on a correctional basis, to cover higher-than desired pre-prandial blood glucose readings (American Diabetes Association [ADA], 2016; Datta et al., 2007). This manner of insulin dosing more closely mimics the body's natural production and release of insulin by the pancreas, and is structured in such a way to proactively address blood glucose fluctuations before they occur rather than treating them retroactively.

Though SSI is still widely used in healthcare settings, extensive research has demonstrated that the BBI approach is a superior treatment methodology when it comes to creating more advantageous patient outcomes. One study of 130 insulin-naïve patients with T2DM in an inpatient setting compared the administration of once-daily glargine and glulisine, a basal-bolus regimen, given prior to meals to a four-times-daily sliding scale administration. The study found that the BBI group saw significantly better blood glucose control than the SSI group, with approximately 67% of the basal-bolus group reaching and maintaining blood glucose targets as compared to approximately 33% of the sliding scale group. Additionally, 14% of SSI group patients had consistently-elevated blood glucose levels despite increased insulin administration, but rapidly improved their glycemic control when switched to the glargine-glulisine regimen (Umpierrez et al., 2007).

Another study conducted in 2007 compared the use of glargine, a basal-only protocol, every 24 hours to a SSI protocol administered every six hours in patients who were status-post gastric bypass surgery (Datta et al., 2007). The study found that the basal group showed an increased level of blood glucose control over the SSI group, with 53% of basal patients meeting blood glucose targets in contrast to the 36% of SSI patients who met targets. The study also found no increased incidence of hypoglycemia among the basal group (Datta et al., 2007).

More recent studies and meta-analyses of SSI versus BBI treatment plans have continued to conclude that basal-bolus is the superior treatment method for hospital patients with hyperglycemia. One meta-analysis by Lee and colleagues in 2015 concluded that mean blood glucose levels and incidence of hyperglycemia were significantly higher in patients treated with SSI than those treated with BBI regimens, and that there was no increase in severe hypoglycemia incidence among BBI patients. Their research led them to conclude that SSI "[does not provide] any benefits in blood glucose control," and that SSI use should be discontinued in hospitals entirely (Lee et al., 2015).

Standards of care

The ADA recommendations for inpatient care of patients with diabetes conforms to the evidence that SSI use in hospitals is not the preferred treatment option for inpatient glycemic control. In their 2016 Standards of Care, the ADA recommends the following in relation to insulin therapy for blood glucose control during inpatient hospital stays:

- A basal plus bolus correction insulin regimen is preferred for non-critically ill patients with poor oral intake or who intake nothing by mouth.
- A basal plus bolus insulin with nutritional and correctional components is preferred for patients with good oral intake.

- The threshold for initiation of insulin therapy to treat sustained hyperglycemia is ≥ 180mg/dl, with a target range for blood glucose between 140-180mg/dl.
- The sole use of sliding scale insulin for inpatient glycemic control is strongly discouraged.

(ADA, 2016)

The American Association of Clinical Endocrinologists (AACE) additionally have their own recommendations for insulin management of type 2 diabetes, with the following key points:

- Patients with A1C >8.0% or long-standing type 2 diabetes, a single daily basal dose of insulin is recommended to meet blood glucose targets. Basal insulin dosage should be adjusted at regular and fairly short intervals to achieve targets without hypoglycemia.
- Basal insulin analogs are preferred to NPH insulin for basal dosing.
- Patients on basal insulin whose blood glucose is still not adequately controlled may require mealtime bolus insulin in addition to basal dosing. Rapid-acting insulin types are preferred to regular types for mealtime bolus dosing.
- A full basal-bolus plan is the most effective insulin regimen.
- Hypoglycemia avoidance is critically important due to increased risk of death and adverse outcomes among patients with a history of one or more severe hypoglycemic events.

(Garber et al., 2016)

Analysis of Potential Barriers

The standards of care recommended by the ADA and the AACE and the overwhelming consistency of research data demonstrate a BBI regimen as the preferred treatment for inpatient

hyperglycemic control. However, SSI use as a standard treatment protocol or hospital policy is still widespread. This indicates that practice barriers to implementation of BBI may exist within the healthcare industry.

Previous Research

Several surveys of medical residents have investigated knowledge, comfort level, and barriers among providers in relation to management of inpatient hyperglycemia. These studies have found that the most common barrier to effective care using basal-bolus insulin regimens over SSI protocols listed by providers were perceived risk of hypoglycemia, often related to the unpredictability of patient mealtimes and scheduled procedures, and lack of knowledge of the most effective insulin regimen (Latta et al., 2011; Cheekati et al., 2009). However, when also asked why they thought sliding scale was still used, 43% of providers surveyed indicated it was due to physician unfamiliarity with ordering nutritional and basal insulins (Latta et al., 2011). Only 33% of providers surveyed in one study in 2011 knew that aspart, a rapid-acting insulin, peaks in 45 to 90 minutes, and only 38% of providers in the same study knew that basal dosing must be adjusted to correct fasting blood glucose levels rather than oral intake (Latta et al., 2011). Similarly, a 2009 study of urban hospital medical residents found that 50% or more of the providers surveyed indicated they were “somewhat comfortable” or “not at all comfortable” with treating hyperglycemia in general, with the same level of comfort reported in over half of providers with regard to ordering insulin (Cheekati et al., 2009).

This research additionally indicates that provider comfort with overall hyperglycemia management principles is directly related to physicians’ choice to order SSI rather than BBI for patients: 65% of respondents who were ‘somewhat comfortable’ with managing hyperglycemia said they would use SSI in “difficult to control blood glucose,” with only 30% of respondents

who considered themselves "very comfortable" with hyperglycemia management reporting the same (Latta et al., 2011). These results were corroborated by personal interactions with active diabetes-focused hospital personnel, who indicated physician comfort level in ordering insulin and general understanding of different insulin types; appropriate order sets and monitoring practices; and fear of hypoglycemia were all factors in physician resistance to a change in insulin policy (J. Swift, personal communication, October 6th, 2016; A. Goley, personal communication, October 11, 2016). These research results establish that SSI regimens are often considered a safer, or more comfortable, choice of glycemic management protocols for providers when compared to basal-bolus insulin regimens, despite being less effective in controlling hyperglycemia.

Potential Nursing Barriers

When asked to identify the largest barriers to better management of inpatient hyperglycemia, medical residents in a 2011 survey indicated that variability in patient diet, mealtime and procedure timing; hypoglycemia risk; and knowledge of the situational appropriateness of different insulin protocols ranked among the top responses (Latta et al., 2011). All of these top responses are potentially relevant to nursing staff behaviors. A diabetes education specialist indicated that fear of hypoglycemia; lack of understanding of dosing protocols; and dosing time requirements for different insulin types appear to have a large role in nurses' lack of confidence with basal-bolus regimens (J. Swift, personal communication, October 6th, 2016). It was additionally indicated that patient meal timing and the timing of procedures contributed to nurses' discomfort with administering non-correctional insulin types (J. Swift, personal communication, October 6th, 2016). Many nurses were confused as to the difference between nutritional (bolus) and correctional insulin (SSI), and indicated to the diabetes education

specialist that they would hold nutritional insulin based on a pre-prandial blood glucose reading below 100 mg/dl, regardless of patient meal status or correctional insulin orders (J. Swift, personal communication, October 6th, 2016). This behavior may be related to lower confidence in administering complex insulin regimes, or confusion surrounding terminology associated with insulin types.

While research into provider comfort levels in prescribing insulin and potential prescriber barriers to basal-bolus insulin procedures exists, limited scholarship is available with regard to the comfort level and potential barriers of inpatient nursing staff and BBI regimens. Given that nurses directly administer insulin at the bedside and possess the capability to make decisions regarding how and when to administer or hold insulin to patients based on clinical judgement, ascertaining whether the similar levels of discomfort and perceived barriers to BBI use exist among nurses could aid in the design of comprehensive targeted education and changes to existing policy. Additionally, through examination of nurse self-reporting of potential barriers, evidence of challenges in BBI administration that are unique to the nursing role can potentially be discovered.

Research Design and Methods

Design

A mixed-methods design was chosen for this study in order to pilot, refine, and establish the validity and reliability of the survey instrument, as well as to obtain rich and valuable data for future studies. Quantitative questions in the survey's first section preceded the open ended, qualitative questions in the survey's second section, with the final section being comprised of demographic questions. There are a total of 21 questions in the survey, and participants are expected to take approximately 15 minutes to complete the survey, though many completed the

survey in less than five minutes. The survey tool is based on previous research regarding provider comfort with insulin ordering (Cheekati et al., 2009; Latta et al., 2011). Similar to previous provider studies, quantitative questions were asked to indicate nurses' comfort levels with insulin administration and measure their perceptions of treatment importance. Demographic data was also collected in this format. These measures were included for ease of data analysis and comparison, as well as to test the reliability of a quantitative question format for future research.

The use of open questions that individual participants may respond to with their own perceptions was added to previously-used survey design to gain insight into potential barriers or challenges that most influence individual nursing practice. By allowing nurses to dictate their own unique responses, trends can be more-easily identified, and responses can be used to tailor future quantitative questions that better target specific barriers in research using more participants and a quantitative study design.

The inpatient hospital setting was chosen for survey administration in order to most appropriately address the research question: *what are the specific barriers for staff nurses to the institution of a basal-bolus protocol as standard practice in major medical centers?* In partnering with medical center research administration, nurse managers on units surveyed were identified as the most effective distributors of the questionnaire in order to increase awareness of the survey among nursing staff and increase response rates. Though involving nurse managers as survey distributors potentially impacts nurse reporting through concern for job repercussions, the electronic survey was designed to maintain confidentiality of survey participants, and all data released to nurse managers and hospital administrators was grouped in order to preserve

anonymity for individual respondents. An electronic format was chosen for participant convenience, and to facilitate rapid, accurate data collection.

Sampling

Convenience sampling methodology was used by administering the survey to inpatient nurses on two hospital units through cooperation with hospital administration. Nurses received the survey electronically through email via their nurse managers, and participation in the survey was completely voluntary. Though the types of patients cared for varied by unit, participants represented a fairly homogenous sample of inpatient medical/surgical nurses within a single hospital environment. The small size of the sample will affect the nature and scalability of results; however, the population of nurses surveyed is closely representative of the population that will be targeted by future intervention efforts related to insulin administration education and policy. Further, the units chosen represented enough diversity in patient care that results related to survey design and the effectiveness of the question format will have a high likelihood of scaling to a larger nursing population in a more diverse selection of inpatient units. All survey respondents were included in the final data set.

Data Collection Instrument

The survey tool used in this project considered principles evident in the modified Mayo Clinic Inpatient Diabetes Attitude Survey used in Cheekati, Osbourne, Jameson, and Cook's 2009 study on resident physicians at an urban hospital. By using background from this and other similar studies, questions were tailored to examine the level of importance nurses place on treating hyperglycemia and avoiding hypoglycemia, as well as nurse comfort level with treating hyperglycemic patients and with administering insulin of various types. An additional question regarding comfort level with insulin terminology was added based on indications from endocrine

and diabetes education staff. Questions on comfort level were formatted similarly to those used for providers in previous studies (Cheekati et al., 2009).

In addition to the multiple-choice questions, questions were also developed to allow free answer responses, allowing nurses to discuss their concerns for patients receiving insulin, the administration of insulin, and how those concerns potentially affect the nursing care they provide. Additional questions were included regarding nurses' interactions with providers regarding insulin orders. These questions were developed to ascertain whether communication with providers was seen as a potential barrier to nurses' confidence in managing insulin regimes. Finally, demographic questions regarding the nurses' work environment were asked, including normal shift, type of unit, level of nursing education, and years of nursing experience in order to track possible response trends among groups working similar shifts or on similar units. The survey tool can be viewed in **Appendix A**.

Research Participants and Data Collection Procedures

The survey was administered at a large university medical center for 13 consecutive days after obtaining approval for the project through both the Institutional Review Board and the facility Nursing Research Council. Two hospital units participated in the survey; a medical/surgical unit catering to general medicine and renal patients, and an acute care cardiac, vascular, and thoracic surgery unit.

Survey recruitment was done through standardized email message sent through the nurse managers on both units. Each email contained a consent information and disclaimer that individual respondent data would not be collected and that participants would be safe from job repercussion. The recruitment emails contained a general, anonymous login link to the electronic survey, powered by Qualtrics. A follow-up reminder message was sent one week after the initial

email was distributed by unit nurse managers. Examples of survey messages can be viewed in **Appendix B**.

Data Analysis

Survey results were collected as soon as they were completed through Qualtrics online survey tools, with quantitative question data from individual survey responses grouped and compared to demographic responses using the same system. Qualitative responses were examined individually in order to identify trends in responses, and then coded to quantitative topic groups based on individual concepts or assertions within responses. Some responses were coded into multiple topic groups based on content. Coded responses were then compared to other quantitative questions and demographic data in order to identify response trends. Both the PI and the Advisor coded and reviewed the data and agreed upon the quantitative data and results as well as qualitative categories. Qualitative responses were categorized both for data analysis and results with regard to this pilot study and for use in future quantitative research.

Results

Demographic Data

A total of 25 nurses across the two units responded to the survey. The respondents were asked to specify the type of unit they worked on through free text rather to protect anonymity of the units surveyed from participants. Participants who responded with variants of “acute care,” “heart and vascular,” “cardiac,” or the name of the cardiac unit were sorted into “Acute Care”, and those who responded with “medicine,” some variant of “medical/surgical,” or the name of the medical/surgical unit were sorted into “Medical/Surgical.” A total of 16 respondents (64%) reported they worked in “Acute Care”, seven (28%) reported they worked in a

"Medical/Surgical" unit, and two (8%) responded with "inpatient" and could not be sorted into either unit.

The majority of nurses surveyed reported having between 1-3 (24%, n=6) years or 5-10 years (32%, n=8) of nursing experience, with 16% (n=4) surveyed reporting 3-5 years or greater than 10 years respectively, and three respondents (12%) being within the less than one year new graduate period. Twenty respondents (80%) reported a Bachelor's of Science in Nursing (BSN) degree as their highest level of education; two respondents (8%) had an Associate's Degree in Nursing (ADN), and three (12%) reported a Master's Degree (MSN) as their highest level of education. The majority (56%, n=14) of respondents primarily worked day shift, with 24% (n=6) reporting night as their primary shift, and 20% (n=5) primarily working rotating shifts. These results can be viewed in **Appendix C.**

When comparing demographic identifiers of the sampled population, it became notable that survey participants with either an ADN or MSN all reported at or greater than three years of nursing experience. Experience categories were fairly evenly distributed among individual units, though nurses who worked on the Medical/Surgical unit were more likely to have a greater level of experience, with 57.14% (n=4) reporting 5 or greater years of experience as compared to 43.75% (n=7) from the Acute Care unit. With regards to experience level and shift type, less experienced nurses were much more likely to work night or rotating shifts, with 40% (n=2) of rotating shift and 50% (n=3) of night shift respondents reporting three or less years of nursing experience.

Perception of Treatment Importance

Overwhelmingly, surveyed nurses indicated that they believed treatment for patients with diabetes is of high priority, with 96% (n=24) of respondents indicating treatment of

hyperglycemia was "very important." Additionally, 100% (N=25) of respondents indicated that preventing hypoglycemia in patients receiving insulin was likewise "very important."

Perceived Confidence as a Barrier to Insulin Administration

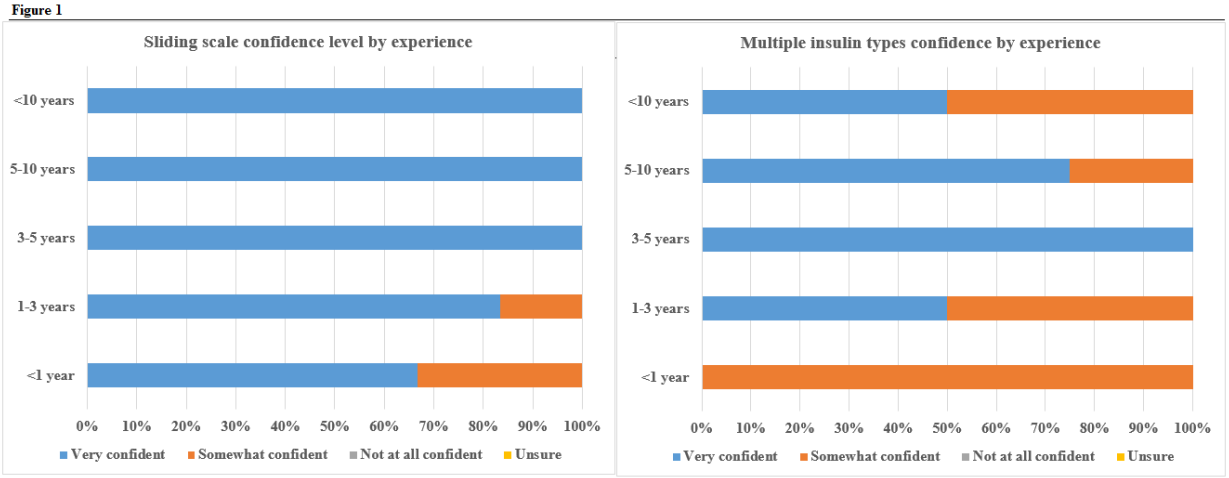
Surveyed nurses reported a higher degree of confidence regarding the administration of sliding-scale insulin when compared to confidence administering multiple insulin types. The broad majority (92%, n=23) of respondents indicated that they were "very confident" in administering insulin on a sliding scale/correctional protocol, with the remaining 8% (n=2) indicating that they were "somewhat confident." No respondents indicated that they were unsure or not confident at all in using SSI alone. However, when asked to rate their comfort in administering multiple types of insulin to a single patient, including basal and bolus insulins in the same shift, only 60% (n=15) of respondents indicated that they were very confident, with the remaining 40% (n=10) indicating they were somewhat confident.

When examined in relation to demographic data, confidence in administering sliding scale insulin was linked to experience, with all participants who were only "somewhat confident" in administering SSI having less than three years of nursing experience; 33.33% (n=1) of new graduates were somewhat confident in SSI administration, and 16.67% (n=1) of nurses with 1-3 years of experience rated themselves "somewhat comfortable." Education level did not show any significant relation to SSI comfort, though differences between units was observed, with only 87.5% (n=14) of nurses working in the acute care unit rating themselves as "very confident" in administering SSI compared to 100% (n=7) in the medical/surgical unit.

In contrast, greater amounts of nursing experience were not consistent with a higher degree of confidence in administering multiple insulin types. New graduate nurses unilaterally rated themselves "somewhat confident" in administering multiple insulin types (n=3), with 50%

(n=3) of those with 1-3 years of nursing experience rating themselves the same way. As with SSI, 100% (n=4) of respondents with 3-5 years of experience rated themselves as "very confident" in administering multiple insulin types; however, the level of confidence dropped in nurses with greater than five years of experience. Nursing veterans (5-10 years) generally rated themselves "very confident" (75%, n=6), but only 50% (n=2) of respondents with greater than ten years of experience rated themselves the same way. A comparison of these results can be viewed in **Figure 1**.

Figure 1



When broken down by shift, nurses working a rotating shift expressed the greatest change in confidence between administering insulin types, with 80% (n=4) of rotating shift respondents rating themselves "very confident" in administering SSI, and the same number (80%, n=4) then indicating that they were only "somewhat confident" with administering multiple insulin types. These results can be viewed in **Appendix D**.

There was no significant indication that confidence in administering insulin was affected by unit. With respect to education, non-BSN nurses had the highest confidence, with ADN and MSN nurses rated themselves as "very confident" 100% of the time (n=2; n=3) with all insulin types. In contrast, BSNs reported lower confidence with multiple insulin types, with only 50%

(n=10) responding "very confident" for multiple insulin types, compared to 90% (n=18) responding the same for SSI.

Percieved Confidence Related to InsulinTerminology

When asked how confident they were with terminology used to describe different methods of insulin administration, surveyed nurses were split, with 52% (n=13) rating themselves "very confident," 44% (n=11) rating themselves "somewhat confident," and 4% (n=1) reporting that they were not at all confident in understanding and using insulin terminology. While responses did not differ significantly by work unit or education level, results indicate a significant correlation between what shift respondents normally work and their level of confidence with insulin terminology, with day shift reporting substaintially more confidence than night or rotating shift respondents. These results can be viewed in **Table 1.**

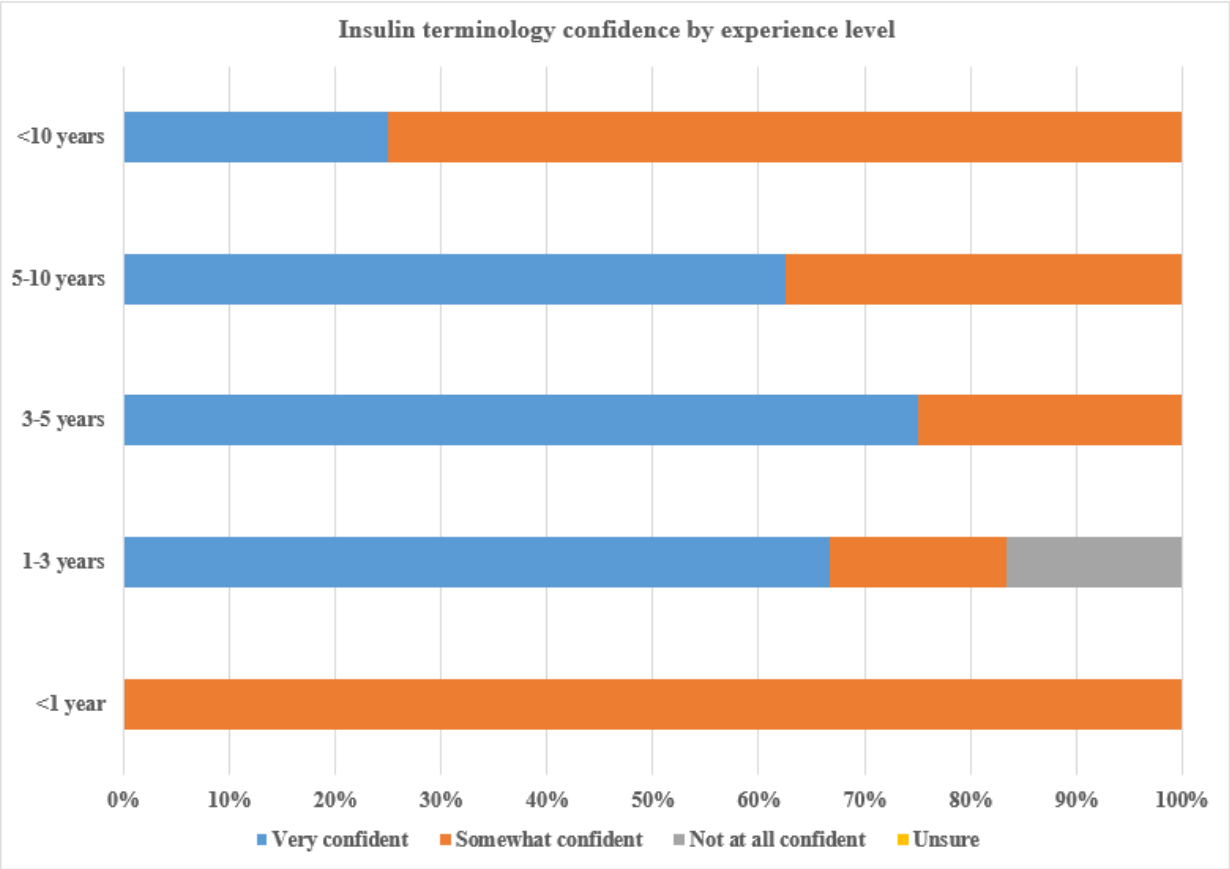
Table 1

Insulin terminology confidence by shift

Level of Confidence	Day	%	Night	%	Rotating	%
Very confident	11	78.57%	1	16.67%	1	20.00%
Somewhat confident	2	14.29%	5	83.33%	4	80.00%
Not at all confident	1	7.14%	0	0.00%	0	0.00%
Unsure	0	0.00%	0	0.00%	0	0.00%
Total	14		6		5	

Nursing experience level showed a similar results distribution to that reported in regards to administration of multiple insulin types, with the largest proportional number of "very confident" responses belonging to those with 3-5 years of experience and lessening confidence indicated with both less and more nursing experience. These results can be viewed in **Figure 2,** as well as **Appendix E**.

Figure 2



Reported concerns for patient care

Insulin Administration concerns

When asked what their greatest concern is when administering insulin to a patient, the responses surveyed nurses provided identified themes in perception regarding insulin among inpatient nursing staff. In examining responses, common themes were grouped into key phrases for the purpose of identifying factors that may drive nurse perception of BBI administration barriers. The 23 provided responses were assigned seven headings, with some responses assigned to multiple headings based on content. These results can be viewed in **Table 2.**

Table 2

Greatest concern when administering insulin to a patient, categories

Category	# of responses	% of responses
Hypoglycemia	8	34.78%
Med Error	8	34.78%
Correct Treatment	5	21.74%
Dietary Intake	4	17.39%
Dosage Timing	4	17.39%
Glucose Monitoring	1	4.35%
None/NA	1	4.35%
Total	23	

“Hypoglycemia” and “med error” were the largest identified concern categories, and were indicated as concerns collectively in 69.56% (n=16) of responses. Individual responses included general concerns such as “causing hypoglycemia,” as well as more specific concerns, including fear of basal insulin at night causing hypoglycemia in the morning; patients with “brittle” diabetes; administration of the wrong dose or wrong type of insulin; and making a medication error while fatigued. The “correct treatment” category included concerns regarding the patient’s individual response to insulin, as well as concern for patients with newly diagnosed diabetes and their need for “a lot of adjustment with insulin.”

Concerns regarding “dosage timing” and “dietary intake” collectively represented the second largest category of responses (34.78%, n=8), and responses within the two categories often overlapped, encompassing concerns regarding administering SSI prior to a patient’s food

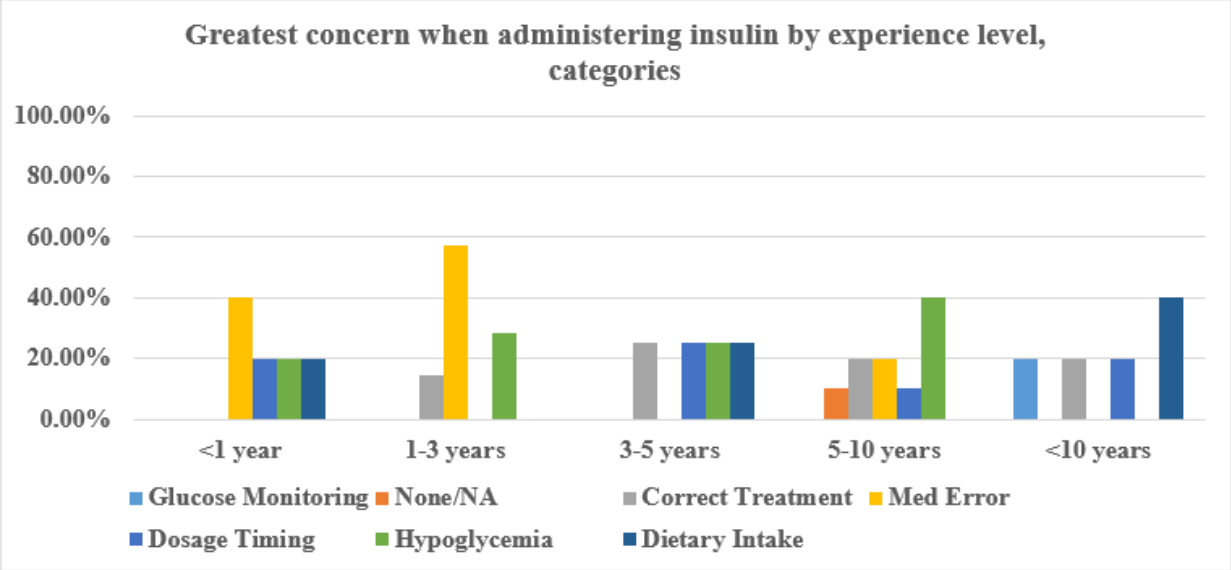
tray arriving; the timeliness of blood sugar checks in relation to meal arrival; patients not eating when expected; and "large Lantus doses when [the patient is] not eating much."

Administration concerns differed substantially based on survey responder demographics, with different units indicating different priorities. The Acute Care unit showed the greatest concern for the "hypoglycemia" and "med error" categories; in contrast, the Medical/Surgical unit was most concerned with whether the patient was receiving the correct treatment. These results can be viewed in **Appendix F.**

Priorities differed across education levels as well: ADN's only reported concerns were "dietary intake" and "dosage timing," while MSNs only reported "hypoglycemia" and "med error" as chief considerations. BSNs were split more evenly between all categories, though "med error" was the most significant concern, represented in 38.89% of responses (n=7).

Most significant was how primary concerns shifted as nursing experience increased. While less experienced nurses were primarily concerned with making medication errors, with 40% of responses for new grads (n=2) and 57.14% of responses for nurses with 1-3 years of experience (n=4) in the "med error" category, only 20% (n=2) of nurses with greater than 5 years experience indicated "med error" as a primary concern, and no nurses with over 10 years of experience indicated it at all. For veteran nurses, the patient's dietary intake was their chief concern (40%, n=2), with "dosage timing," "correct treatment," and ensuring accurate blood glucose monitor readings being their only other listed concerns. These results are displayed graphically in **Figure 3**, with numeric results displayed in **Appendix G.**

Figure 3



Overall concerns

When asked to respond with their greatest overall concern for their patients receiving insulin, surveyed nurses responded differently and in a more detailed fashion than with the individual concern question. Yet, 52% of responses (n=13, N=25) still indicated “hypoglycemia” as a significant overall concern, and hypoglycemia concerns overlapped heavily with responses indicating concerns of “dietary intake,” “correct treatment,” and “med error.” Discrepancies in home treatment and hospital care for patients with diabetes were often associated with concerns regarding education and patient compliance with treatment. Responses additionally indicate that uncertainty from patients who take oral anti-hyperglycemic agents at home and are switched to insulin therapy in the hospital leads to the perception of problems with treatment. Results can be viewed in **Table 3.**

Table 3

Greatest overall concern for patients receiving insulin, categories

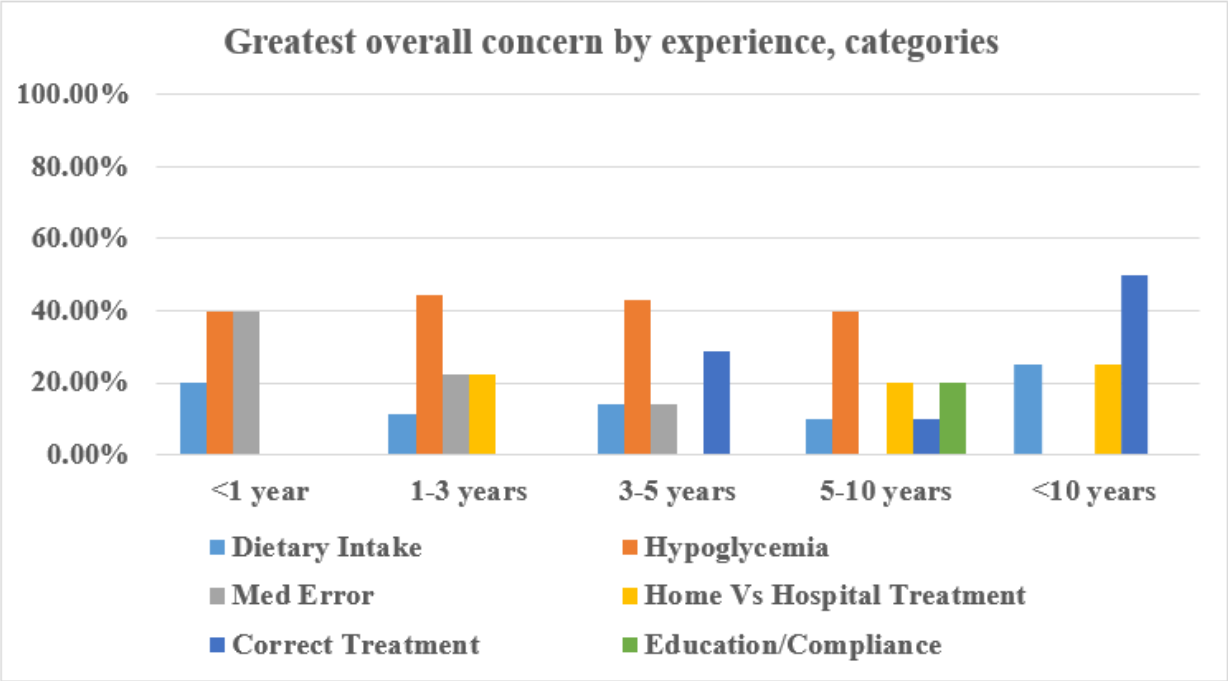
Category	# of responses	% of responses
Med Error	5	20.00%
Hypoglycemia	13	52.00%
Home Vs Hospital Treatment	5	20.00%
Education/Compliance	2	8.00%
Dietary Intake	5	20.00%
Correct Treatment	5	20.00%
Total	25	

Demographic responses impacted reported overall concerns heavily. As with administration concerns, units displayed different priorities: the Acute Care unit indicated "hypoglycemia" as the primary overall concern (41.67%, n=10); in contrast, the Medical/Surgical unit indicated concerns relating to patient home treatment and discharge planning, with "home vs hospital treatment" occupying the largest proportion of responses (44.44%, n=4).

With regard to experience level, "hypoglycemia" and "med error" were primary concerns for less experienced nurses, with both concerns represented in greater than 40% of responses for nurses with between 1-5 years' experience and 80% (n=4) of new graduate responses. However, while hypoglycemia concerns were well represented in responses from the 5-10 year experience group, "med error" concerns diminished as experience grew, with no nurses with greater than 5

years of experience indicating it as a primary concern. Veteran nurses with greater than 10 years' experience were most concerned with whether their patients were receiving the right treatment. These results are displayed graphically in **Figure 4.**

Figure 4



When asked how the listed concern affects their overall nursing care, surveyed nurses primarily indicated that it would cause them to exercise extra caution or double-check themselves when providing care to these patients (42.86%, n=9), or that the concern would cause them to focus on educating the patient (38.10%, n=8). Responses from those indicating their greatest overall concern would cause them to be more cautious in their care included double-checking medicine doses and dietary considerations before administering insulin, being conservative with insulin administration for NPO or vomiting patients, and checking on patients more frequently.

Perceptions of Provider Feedback

Surveyed nurses were asked if they had ever given a provider feedback regarding an insulin order, and were asked to clarify what the feedback was if an affirmative response was given. Out of 25 respondents, 24 (96%) indicated that they had given feedback to a provider regarding an insulin order.

When asked to elaborate on what feedback was given, responses primarily focused on requests for modifications to orders based on patient care concerns, asking for clarification, or requesting provider support for education or requesting a consult. As with responses regarding concerns for insulin administration, responses were grouped into categories, with some responses falling in to multiple categories based on content.

The primary reason nurses reported that they contacted providers regarding insulin orders was to inquire about the appropriateness of the ordered dose, with 57.14% (n=12) of responses involving this category. "Clarification of communication" was separated from "requesting a modification to an order", which was the second most prevalent reason reported at 38.10% (n=8) of responses. Other reasons for provider communication reported by survey respondents include requesting endocrine service consults, requesting that the provider perform a function in patient education, and concerns for differences between patients' home and hospital treatment plans.

Further analysis on responses included whether the communications explicitly indicated they were concerned with basal insulin orders or sliding scale orders. Of the total 21 (42.86%) responses, nine explicitly mentioned "basal insulin," "Lantus," or "glargine," with only three responses (14.29%) explicitly mentioning "sliding scale," "SSI," or specific insulins used in sliding scale or correctional protocols. However, many responses did not specify the type of insulin order in their response, and therefore nine responses (42.86%) fell into neither category.

As a second follow-up, respondents were asked to describe how the provider responded when they contacted them for the purpose of assessing perceptions of surveyed nurses regarding communication with providers as a potential barrier. Responses were categorized as "positive," "negative," or "mixed" based on content. Responses such as "changed the order," "positively," and "well received" were considered "positive", with answers such as "can't you just call the diabetes educator," representing "negative" feedback. "Mixed" responses often contained the words "mixed" or "depends." Overwhelmingly, surveyed nurses indicated that they received a positive response from providers when they reached out regarding insulin orders, with 17 of 21 responses (80.95%) indicating a "positive" response, and only one response (4.76%) indicated a strictly "negative" provider response. Three responses (14.29%) were mixed.

Respondents were then asked if they had ever wished to give providers feedback, but chosen not to do so. This was asked in order to further examine potential reservations regarding contacting providers. Of 24 responses, five (20.83%) indicated that they had wanted to give feedback to a provider, but had chosen not to. However, when asked in follow-up what the feedback was, only two responses were given, and both represented concerns regarding the appropriateness of order insulin dosing. Of these respondents who answered the follow-up, only one answered a second follow-up question regarding the reason why they chose to hold their feedback: the response indicated that the respondent chose not to follow up due to deference to provider knowledge.

Discussion

Potential Barriers

Confidence with basal-bolus administration and terminology

Study data demonstrates that surveyed nurses are significantly less confident in administering multiple insulin types, including basal and bolus insulins, than they are in administering SSI. These results are similar to research done regarding provider confidence, where lower confidence levels in treating hyperglycemia in general correlated to higher ordering of SSI (Latta et al., 2011).

In particular, results suggest that a prevalent concern among inpatient nurses surveyed is causing hypoglycemia as a result of inappropriate insulin administration. In individual responses, many nurses indicated how they would modify their behavior surrounding insulin administration in an attempt to prevent hypoglycemic events. Examples of responses include:

> "I may be more conservative when giving insulin to patients especially those who are NPO."
>
> "I have concerns when I am administering a large amount of SSI to pts when their food tray is not readily available, even when their BS is high."
>
> "[Concern regarding] food intake, large Lantus doses when not eating much."

The relationship between food availability and insulin administration was common in responses, both with regard to SSI administration and when nurses were discussing basal insulin. The lack of consistency respondents indicated regarding how to handle basal insulin in situations where patients had poor oral intake was apparent in responses regarding communications with providers, many of which included asking for clarification or modification of basal doses. Examples include:

> "Suggested that the MD hold the patient's scheduled insulin glargine because of a low blood sugar or cutting the dose in half."

"To adjust the dosages of long-acting insulins when patients will be NPO after midnight."

"Clarify amount of Lantus insulin to be administered when patients are NPO for tests/procedures."

"[Asked MD] about basal loading doses."

"I clarified the dose of basal insulin since the patient was NPO after midnight for a procedure in the morning. The prescriber adjusted the dose by decreasing it."

It is important to note that the ADA recommends basal plus correctional protocols for patients who are receiving nothing by mouth or have poor oral intake, primarily contradicting the perception evident in individual survey responses that patients require reduction or elimination of basal insulin in these situations. ADA guidelines indicate prevention of hypoglycemia in these patients is better achieved through the reduction or elimination of nutritional insulin, which is explicitly related to oral intake, while basal insulin is not (ADA, 2016).

Survey results also indicate that education is a factor in respondent's confidence levels when administering multiple insulin types: nurses with less than three years of experience show similar confidence levels to nurses with greater than five years of experience, both of which are lower than confidence levels reported by nurses with 3-5 years of experience. This indicates that the confidence gained with increased professional experience may be counteracted by a greater amount of time passing since completion of formal nursing education in more experienced nurses. These conclusions are further supported by results relating to confidence with insulin terminology: nurses with less than one year and greater than ten years of nursing experience reported themselves "somewhat confident" with regards to insulin terminology in 100% and 75% of responses respectively, compared to the respondents with between 1-10 years of experience,

who only rated themselves "somewhat confident" in less than 40% of responses. These results indicate that, while new graduate nurses may need greater clinical experience to feel comfortable with more complex insulin regimens, nurses with greater than 10 years of experience may require refresher courses or continuing education to keep up with changing trends in insulin use and changing insulin terminology.

Continuing education availability may explain comfort differences in insulin terminology by shift. Day shift respondents were much more confident with regards to terminology than either night or rotating shifts, which may be associated with higher access to in-service education and more interaction with rounding provider teams among day shift nurses, though this hypothesis would require further investigation to confirm.

Fear of hypoglycemia and medication administration errors

Surveyed nurses consistently indicated that fear of hypoglycemia and fear of making a medication error were primary concerns for them with regards to caring for patients receiving insulin. While fear of hypoglycemia was identified as a provider-side barrier in previous research, fears regarding medication administration errors are unique to nursing staff (Latta et al, 2011). Results indicate that this fear of errors is particularly prevalent among less experienced nurses when compared to their more experienced counterparts. Concerns regarding hypoglycemia and medication error related to insulin administration were reported by 69.56% of nurses surveyed overall, with higher rates reported from less experienced nurses and those working in the Acute Care unit over the Medical/Surgical setting.

The differences in reported concerns by unit may be explained by how frequently nurses on each unit care for patients with diabetes, as well as particular unit priorities and culture. Results indicating that less experienced nurses report higher concerns for hypoglycemia/medication error

than their more experienced counterparts may indicate that less experienced nurses are more likely to feel insecure administering medications in general.

However, all of these concerns must be examined in the context of how basal-bolus insulin (BBI) regimens differ from SSI regimens. BBI administration requires knowledge of and confidence with a greater variety of insulin types, and often involves a greater total volume of insulin administration per patient when compared to SSI. This makes BBI regimens more technically complex for nurses to administer, which increases the potential likelihood of, and fear of, making a medication administration error. Similarly, confusion regarding different insulins' uses and when different insulin types should be held or reduced indicates that nurses may perceive BBI regimens as more likely to cause hypoglycemia in their patients, despite that randomized control trials have shown that BBI dosing does not raise incidence of hypoglycemia when compared to SSI use (Datta et al., 2007).

When considering that nurses are significantly less comfortable with the administration, the terminology, and specific indications of BBI insulin types, the fear of hypoglycemia and medication errors can be seen as a particularly 'sharp end' to many of the individual barriers impeding effective BBI protocol administration. These results indicate that further education and more explicit insulin administration protocols and policies may improve nurses' confidence in administration of more complex insulin regimes, with the education component acting as an essential consideration.

Factors Unlikely to be Barriers

Perception of treatment importance

Participating nurses overwhelmingly (92%) indicated that they believed that treating hyperglycemia was very important, indicating that investment in overall treatment is not likely to

be a barrier among nurses to implementing BBI regimens. This can be viewed in contrast to a study of provider perceptions, which found that in non-critically ill patients, only 65% of providers indicated that treatment of hyperglycemia was 'very important,' with the remaining 35% rating it "somewhat important" (Latta et all, 2011). These results indicate that obtaining buy-in on the treatment of hyperglycemia may be easier with nurses than it is with providers, since nurses already believe in the importance of managing hyperglycemia.

With regards to prevention of hypoglycemia, survey respondents unanimously indicated that it was "very important," and the depth of concern given to hypoglycemia was also reflected in responses to qualitative questions, with more than 52% of individual responses involving hypoglycemia when asked what their primary concern was for patients receiving insulin. The prevalence of hypoglycemia as a chief concern with regard to insulin administration regimens is consistent with previous research on providers (Latta et al, 2011; Cheekati et al, 2009).

Perception of provider interaction

Surveyed nurses indicated that they were willing to communicate with providers regarding insulin orders, whether for purposes of requesting changes to those orders or clarification on dosing and that the providers primarily responded positively to their communications. These results indicate that fear of complex provider interactions surrounding insulin is unlikely to be a significant nursing barrier, at least within the surveyed population. However, the difference between how many surveyed nurses responded that they withheld provider feedback and the lack of responses indicating the substance of the feedback and why it was withheld was significant enough to warrant further consideration and study. Further, the positive nature of surveyed nurses' perceptions of provider feedback can potentially be attributed

to the culture of the medical center or the individual units; therefore, broader study of other medical centers may generate different results.

Indications for future research

The survey administered in this study can be considered to be successful in its intended objectives, both in providing useful, rich data on potential nursing barriers for further investigation, but also in providing data necessary to refine questions for more comprehensive, quantitative studies in the future.

Confidence questions, which had been previously tested in other similar studies of providers, generated comprehensive data from respondents, especially when combined with demographic data factors. However, demographic questions require some modification, specifically to allow a minimum of respondent self-entry, considering that some demographic data was lost due to entries that were too vague, such as answering "inpatient" for unit type (Cheekati et al., 2009; Latta et al, 2011). A fully quantitative format would be preferable in future studies to gain more consistent, reliable insight.

Even with a small sample, trends in responses were identified through nurses' self-reporting of concerns and the translation of those concerns into potential barriers. Identified barrier categories can be investigated in a more detailed, quantitative manner in future studies by examining each category separately, or by allowing nurses to prioritize categories from most to least concerning. However, due to the small sample size, further use of this survey on a larger, more diverse nursing population would be ideal in order to continue to validate the identified categories before they can reliably be used in quantitative research.

A potential area of improvement and further investigation is specific perceptions among nurses regarding basal insulin and nutritional insulin and their functions. Results identified that

many nurses may possess misconceptions about the particular functions and desired protocols for each different type of insulin, and more specific questions focused on basal, nutritional, and correctional insulins, including confidence measures and skill-type or scenario questions, could yield important data in future studies. Additionally, questions related to provider interaction yielded behavioral results surrounding administration of different insulin types, and the core of these questions could be modified to focus specifically on what requests nurses' make regarding provider orders and why they make them, potentially yielding more complete data that could be used to target education. Perceptions of provider feedback could then be addressed in separate questions, with provider feedback questions having a subsequent qualifier attached to clarify whether nurses were contacting providers regarding BBI insulins, SSI insulin protocols, or both.

Study limitations

Small sample size, lack of diversity in sampled groups work locations, and the relatively homogenous nature of participants as inpatient nurses working at the same hospital within the medical/surgical realm of care were all limitations of this study. Further research based on the results of this pilot study will seek to mitigate these potential limitations by including more participants and more facilities, and including a larger scope of nursing practice locations, such as emergency departments and more specialized units.

Conclusions

The results of this study indicate nurses overwhelmingly believe that treating hyperglycemia is very important, exceeding provider perceptions of importance indicated by prior research. Nurse confidence in BBI administration, fear of hypoglycemia and medication errors, and concerns about different insulin types and their specific roles in the treatment of

hyperglycemia are all potentially significant nursing staff barriers to the implementation of a BBI policy within major medical centers.

The categorical themes of hypoglycemia, potential medication errors, education, dietary intake and meal timing, home versus hospital treatment, and whether the patient was receiving the correct treatment were identified from participating nurses' self-report of their concerns regarding insulin administration and hyperglycemia treatment. These themes can be used to further refine future quantitative research on larger nurse populations, allowing for more reliable data to be collected regarding nursing barriers.

While more research is necessary, identified themes and potential barriers have clear implications for education and policy efforts undertaken by medical centers when attempting to institute BBI regimens as standard practice.

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Appendix A – Survey Tool

Nursing Insulin Administration Pilot Survey

Q1 This survey is part of a research study. This survey asks for your perceptions of the practice surrounding the administration of insulin to patients in your clinical area. All information is confidential and your supervisor will not receive individual feedback but will rather have a cluster of information based upon responses. There will be no impact upon your job or your professional standing from participating in this survey. All participation is voluntary. If at any point in the survey you choose to stop it is your choice. If you have difficulties with any items please do not hesitate to contact us.

- ○ Continue (1)
- ○ Do not continue (2)

If Do not continue Is Selected, Then Skip To End of Survey

Q2 How would you rate the importance of treating inpatient hyperglycemia?

- ○ Very important (1)
- ○ Somewhat important (2)
- ○ Not at all important (3)
- ○ Unsure (4)

Q3 How would you rate the importance of avoiding hypoglycemia in patients on an insulin protocol?

- ○ Very important (1)
- ○ Somewhat important (2)
- ○ Not at all Important (3)
- ○ Unsure (4)

Q4 How confident are you administering regular or aspart insulin on a sliding scale/correctional protocol?

- ○ Very confident (1)
- ○ Somewhat confident (2)
- ○ Not at all confident (3)
- ○ Unsure (4)

Q5 How confident are you administering multiple types of insulin to a single patient, such as basal and bolus insulins, in one shift?
- ○ Very confident (1)
- ○ Somewhat confident (2)
- ○ Not at all confident (3)
- ○ Unsure (4)

Q6 How confident are you with terminology used to describe different methods of insulin administrations? Examples include: sliding scale, correctional, basal-bolus, nutritional, basal insulin, etc.
- ○ Very confident (1)
- ○ Somewhat confident (2)
- ○ Not at all confident (3)
- ○ Unsure (4)

Q7 What is your greatest concern when administering insulin to a patient?

Q8 What is your greatest overall concern for your patients that are receiving insulin?

Q9 How does the above concern affect your nursing care of your patients receiving insulin?

Q10 Have you ever given feedback to a prescriber regarding an insulin order?
- ○ Yes (1)
- ○ No (2)

Display This Question:
If Have you ever given feedback to a prescriber regarding an insulin order? Yes Is Selected

Q11 If so, what was the feedback?

Display This Question:
If If so, what was the feedback? Text Response Is Displayed

Q12 How did the prescriber respond?

Q13 Have you ever wanted to give feedback to a prescriber regarding an insulin order and chosen not to?
- ○ Yes (1)
- ○ No (2)

Display This Question:
If Have you ever wanted to give feedback to a prescriber regarding an insulin order and chosen not to? Yes Is Selected

Q14 If so, what was the feedback?

Display This Question:
If If so, what was the feedback? Text Response Is Displayed
Q15 Why did you choose not to give feedback?

Q16 Are there particular nursing care considerations or interventions you implement specifically with patients who are receiving insulin?
- Yes (1)
- No (2)

Display This Question:
If Are there particular nursing care considerations or interventions you implement specifically with patients who are receiving insulin? Yes Is Selected
Q17 If so, what are they?

Q18 What type of unit is your primary work location?

Q19 How many years have you been working in the nursing field?
- <1 year (1)
- 1-3 years (2)
- 3-5 years (3)
- 5-10 years (4)
- <10 years (5)

Q20 What is the highest level of nursing education you have completed?

Q21 What shift do you normally work on your primary unit?

Appendix B – Recruitment Messages

Initial Email

Hello Nursing team!

I am an undergraduate nursing student in my senior year. This year I've had the privilege of being able to undertake a research project around a subject I'm very interested in: insulin administration and diabetic care in inpatient settings! Through my research, I am attempting to look at the attitudes, comfort levels, and special considerations of inpatient nurses when it comes to administering insulin to their patients. Based on these goals, I have developed a quick online, anonymous survey intended to be filled out by nurses. The survey takes approximately 15 minutes to complete in its entirety, and no personal identification information will be collected through it.

I would greatly appreciate your help in this research project. The survey link is contained below:

[Insert Link Here]

Consent Information:

This survey is part of a research study being conducted by an undergraduate nursing student at UNC-CH School of Nursing. This survey asks for your perceptions of the practice surrounding the administration of insulin to patients in your clinical area. All information is confidential and your supervisor will not receive individual feedback but will rather have a cluster of information based upon responses. There will be no impact upon your job or your professional standing from participating in this survey. All participation is voluntary. If at any point in the survey you choose to stop it is your choice. If you have difficulties with any items please do not hesitate to contact us.

Follow up reminder:

Hello Nursing team!

This email is just a reminder regarding the research survey on insulin administration sent out [indicate time frame] ago. If you have already completed the survey, thank you so much! Here is the survey link:

[Insert link here]

As a reminder, the purpose of this survey, as part of an undergraduate research project, is to look at the attitudes, comfort levels, and special considerations of inpatient nurses when it comes to administering insulin to their patients. The survey takes approximately 15 minutes to complete in its entirety, and no personal identification information will be collected through it.

Thank you so much again for your help!

Consent Information:

This survey is part of a research study being conducted by an undergraduate nursing student at UNC-CH School of Nursing. This survey asks for your perceptions of the practice surrounding the administration of insulin to patients in your clinical area. All information is confidential and your supervisor will not receive individual feedback but will rather have a cluster of information based upon responses. There will be no impact upon your job or your professional standing from participating in this survey. All participation is voluntary. If at any point in the survey you choose to stop it is your choice. If you have difficulties with any items please do not hesitate to contact us.

Appendix C

Survey respondent primary shift			*Survey respondent level of nursing experience*			*Survey respondent level of nursing education*		
Shift Type	**Responses**	**%**	**Experience**	**Responses**	**%**	**Education**	**Responses**	**%**
Day	14	56.00%	<1 year	3	12.00%	ADN	2	8.00%
			1-3 years	6	24.00%			
Night	6	24.00%	3-5 years	4	16.00%	BSN	20	80.00%
			5-10 years	8	32.00%			
Rotating	5	20.00%	>10 years	4	16.00%	MSN	3	12.00%
Totals	25		Totals	25		Totals	25	

Appendix D

Sliding scale confidence by shift

Level of Confidence	Day	%	Night	%	Rotating	%
Very confident	13	92.86%	6	100.00%	4	80.00%
Somewhat confident	1	7.14%	0	0.00%	1	20.00%
Not at all confident	0	0.00%	0	0.00%	0	0.00%
Unsure	0	0.00%	0	0.00%	0	0.00%
Total	14		6		5	

Multiple insulin types confidence by shift

Level of Confidence	Day	%	Night	%	Rotating	%
Very confident	10	71.43%	4	66.67%	1	20.00%
Somewhat confident	4	28.57%	2	33.33%	4	80.00%
Not at all confident	0	0.00%	0	0.00%	0	0.00%
Unsure	0	0.00%	0	0.00%	0	0.00%
Total	14		6		5	

Appendix E

Insulin terminology confidence by experience level

Level of Confidence	<1 year	%	1-3 years	%	3-5 years	%	5-10 years	%	<10 years	%
Very confident	0	0.00%	4	66.67%	3	75.00%	5	62.50%	1	25.00%
Somewhat confident	3	100.00%	1	16.67%	1	25.00%	3	37.50%	3	75.00%
Not at all confident	0	0.00%	1	16.67%	0	0.00%	0	0.00%	0	0.00%
Unsure	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Total	3		6		4		8		4	

Appendix F

Greatest concern when administering insulin by unit, categories

Category	Medical/Surgical	%	Acute Care	%
Hypoglycemia	1	14.29%	6	42.86%
Correct Treatment	3	42.86%	1	7.14%
Med Error	1	14.29%	6	42.86%
Dietary Intake	1	14.29%	3	21.43%
Dosage Timing	1	14.29%	3	21.43%
Glucose Monitoring	1	14.29%	0	0.00%
None/NA	0	0.00%	1	7.14%
Total	7		14	

Appendix G

Greatest concern when administering insulin by experience, categories

Category	<1 year	%	1-3 years	%	3-5 years	%	5-10 years	%	<10 years	%
Glucose Monitoring	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	20.00%
None/NA	0	0.00%	0	0.00%	0	0.00%	1	10.00%	0	0.00%
Correct Treatment	0	0.00%	1	14.29%	1	25.00%	2	20.00%	1	20.00%
Med Error	2	40.00%	4	57.14%	0	0.00%	2	20.00%	0	0.00%
Dosage Timing	1	20.00%	0	0.00%	1	25.00%	1	10.00%	1	20.00%
Hypoglycemia	1	20.00%	2	28.57%	1	25.00%	4	40.00%	0	0.00%
Dietary Intake	1	20.00%	0	0.00%	1	25.00%	0	0.00%	2	40.00%
Total	3		5		3		8		4	